

CLAIMS

1. Programming system for a robot, or similar automatic apparatus, bearing a tool (4), the system comprising a control unit (5), operative to control  
5 movements of the robot (1) according to multiple axes, and a portable programming terminal (6) operatively connected to the control unit (5), where the terminal (6) comprises
- selection means (18), able to be operated  
10 manually to select a desired co-ordinate system among a plurality of co-ordinate systems ("Base, "Tool", "Joints") stored in the control unit (5);
  - first motion control means whose operation depends on a selection made through the selection means  
15 (18), the first motion control means comprising a plurality of motion keys (14) able to be operated manually to provide the control unit (5) with a respective command signal for the robot (1), the command signal being aimed at causing the tool (4) to  
20 execute a rotation or a translation motion about or along an axis corresponding to the operated motion key (14), in the co-ordinate system ("Base, "Tool", "Joints") selected using the selection means (18),
  - position teaching means (21), able to be operated  
25 manually to store a position reached by a predefined point (TCP) of the tool (4) as a result of a motion of the robot (1),
- characterised in that the terminal (6) further comprises additional motion control means (40, 41),  
30 able to be operated manually instead of the first motion control means (14), to provide the control unit (5) with a respective signal for controlling the robot (1) aimed at causing a displacement of the predefined point (TCP) of the tool (4) relative to a previously  
35 set reference point (CO), where

- the position of the reference point (CO) is capable of being modified,

- the terminal (6) comprises means (D; T) for modifying the position of the reference point (CO),

5       - the signal for controlling the robot (1) generated as a result of the operation of the additional motion control means (40, 41) is independent from the co-ordinate system ("Base, "Tool", "Joints") selected through the selection means (18).

10       2. System as claimed in claim 1, characterised in that the reference point (CO) is representative of the position of the terminal (6), and hence of a user (7) who supports it, relative to the robot (7).

15       3. System as claimed in claim 1, characterised in that the additional motion control means (40, 41) are able to be operated to cause Cartesian displacements of the predefined point of the tools (TCP) relative to the set reference point (CO).

20       4. System as claimed in claim 1, characterised in that the additional motion control means (40, 41) can be operated to cause angular or rotary displacements about a respective axis of the predefined point of the tools (TCP).

25       5. System as claimed in claim 2, characterised in that the additional motion control means (40, 41) can be operated to cause a displacement of the predefined point of the tool (TCP) closer, farther away, to the right, to the left, upwards or downwards relative to the position of the terminal (6), and hence of the user  
30       who supports it (7).

35       6. System as claimed in claim 5, characterised in that the additional motion control means (40, 41) comprise a compass knob (40) able to be selectively operated in four lateral areas thereof to cause, in one of its operating modes, a displacement of the

predefined point of the tool (TCP) closer, farther away, to the right or the left relative to the position of the terminal (6).

7. System as claimed in claim 5, characterised in  
5 that the additional motion control means (40, 41) comprise a dual pressure key (41), able to be operated selectively at its two end areas to cause, in an operating mode thereof, a displacement of the predefined point of the tool (TCP) upwards or downwards  
10 relative to the position of the terminal (6).

8. System as claimed in claim 2, characterised in that the additional motion control means (40, 41) can be operated to cause a rotation of the predefined point of the tool (TCP) about a respective axis, counter-  
15 clockwise or clockwise to the right, counter-clockwise or clockwise towards the position of the terminal (6) and counter-clockwise or clockwise upwards.

9. System as claimed in claim 6, characterised in that the compass knob (40) can be selectively operated  
20 in four lateral areas therefor to cause, in an additional operating mode, a displacement of the predefined point of the tool (TCP) about a respective axis, counter-clockwise and clockwise to the right and counter-clockwise and clockwise towards the position of  
25 the terminal (6).

10. System as claimed in claim 7, characterised in that the dual pressure key (41) can be selectively operated at two end areas thereof to cause, in an additional operating mode, a rotation of the predefined  
30 point of the tool (TCP) about a respective axis, counter-clockwise or clockwise upwards.

11. System as claimed in claim 1, characterised in that the terminal (6) comprises a display device (D) and in that the means (D; T) for modifying the position  
35 of the reference point (CO) comprises an information

input page capable of being displayed on the display device (D).

12. System as claimed in claim 1, characterised in that the means (D; T) for modifying the position of the reference point (CO) comprise at least a first key (20, 5 24) of the terminal (6).

13. System as claimed in claim 12, characterised in that the means (D; T) for modifying the position of the reference point (CO) comprise a display device (D) of 10 the terminal (6) and means for generating graphic information on the display device (D), the graphic information being representative of the position of the reference point (CO) relative to the robot (1).

14. System as claimed in claim 13, characterised in 15 that the means for generating graphic information comprise

- means for generating on the display (D) a first symbol (CO), representative of the reference point,
- means for generating on the display (D) a second 20 symbol (PR), representative of the robot (1);
- means for moving the first symbol (CO) relative to the second symbol (RR) using the first key (20), in particular along a substantially circular trajectory (TC).

25 15. System as claimed in claim 2, characterised in that the means (D; T) for modifying the position of the reference point (CO) are part of a system (T, R) for the automatic recognition of the angular position of the terminal (6) relative to the robot (1).

30 16. System as claimed in claim 15, characterised in that the automatic recognition system (T, R) comprises signal emitter means (T) and signal receiving means (R), the signal emitter means (T) being operatively associated to one between the terminal (6) and the 35 robot (1) and the signal receiver means (T) being

operatively associated to the other between the terminal (6) and the robot (1).

17. System as claimed in claim 1, characterised in that the terminal (6) comprises a longitudinally  
5 extended body defining a first portion (10) and a second portion (11) having an area of union to the first portion (10), the width of the second portion (11) being progressively decreasing until reaching the union area.

10 18. System as claimed in claim 17, characterised in that in correspondence with a front side of the first portion (10) is provided a display device (D) and in correspondence with a front side of the second portion (11) is provided a multiplicity of keys.

15 19. System as claimed in claim 18, characterised in that the additional motion control means (40, 41) are positioned in a central part of the second portion (11).

20 20. System as claimed in claim 18, characterised in that the first motion control means comprise a first series of motion keys (14) and a second series of motion keys (14), the two series being positioned in substantially symmetrical fashion, each along a  
25 respective longitudinal side of the second portion (11).

21. System as claimed in claim 20, characterised in that the first series consists of keys for controlling translation movements and the second series consists of keys for controlling rotation movements.

30 22. System as claimed in claim 20, characterised in that the additional motion control means (40, 41) are positioned between the first and the second series of motion keys (14).

23. System as claimed in claim 1, characterised in  
35 that the terminal (6) comprises a safety device of the

"dead man" type (13).

24. System as claimed in claim 23, characterised in that the terminal (6) comprises a body in whose rear part is defined a longitudinally extended recess (12),  
5 from each of the two opposite longitudinal sides of the recess (12) projecting towards the interior of the recess an elongated button (13), each elongated button (13) being part of the safety device.

25. System as claimed in claim 18, characterised in  
10 that said multiplicity of keys comprises one or more keys selected in the group consisting of:

- at least a key (15) for varying the translation velocity of the robot (1), positioned substantially in the right part of the second portion (11), towards the  
15 centre thereof;

- a key (16) for starting a sequence of motions of the robot (1), positioned in the right part of the second portion (11), towards the centre thereof;

- a key (17) for stopping a motion of the robot  
20 (1), positioned in the right part of the second portion (11), towards the centre thereof;

- a key (18) for selecting a desired co-ordinate system among a plurality of co-ordinate systems, positioned in the left part of the second portion (11),  
25 towards the centre thereof;

- a repetition key (19), which, when pressed, causes the robot (1) to trace back one or more previously executed motions, positioned in the right part of the second portion (11), towards the centre  
30 thereof;

- a key (26) for commanding the execution of individual steps of a previously set sequence of motions of the robot (1), positioned in the right part of the second portion (11), towards the centre thereof;

- a plurality of programming keys (20-23)

positioned in the left part of the second portion (11) and comprising at least multiple cursor keys (20), a data recording key (21), a data modification key (22);

5       - a plurality of keys of an alphanumeric keypad (23) positioned in a central part of the second portion (11).

26. System as claimed in claim 18, characterised in that in the first portion (10), laterally to the display device (D), are positioned one or more keys  
10       selected within the group consisting of:

      - at least two keys (24, 25) for selecting or navigating among options of a menu able to be displayed on the display device (D), one of said keys being vertically offset relative to the other;

15       - a help key (28) for obtaining help information on the display device (D);

      - a plurality of function keys (TF1, TF2, TF3).

27. System as claimed in claim 18, characterised in that in correspondence with an end area of the first  
20       portion (11) are positioned a key selector (31) and a mushroom head safety push-button (32).